University of California at Berkeley
Physics 129A
Professor Freedman
Fall 2004
September 19, 2004
Homework #3 (Due: Friday September 24)

1. Using the angular momentum latter operators J_+ and J_- construct a table of angular momentum coupling constants appropriate for combining angular momentum $J_1 = 1$ with angular momentum $J_2 = 1$, to get the $J = J_1 + J_2$ representations. You may note that there are ambiguities in the phase of the coefficients but you should be able to compare your results with the table on the PDG web site (http://pdg.lbl.gov/).

2. The Hamiltonian for an axial symmetric rotator is

$$H = \frac{L_x^2 + L_y^2}{2I_1} + \frac{L_z^2}{2I_3}$$

(a) What are the eigenvalues of H?
(b) Sketch the spectrum, assuming that $I_1 > I_3$.
(c) What is the spectrum in the limit that I_1 is much larger than I_3?

3. A Λ-hyper nucleus is one in which a neutron is replaced by a bound Λ-hyperon. ${}^4He_\Lambda$ and ${}^4H_\Lambda$ is a doublet of mirror hyper nuclei. Deduce the ratio of the reaction rates

$$K^- + {}^4He \rightarrow {}^4He_\Lambda + \pi^-$$

$$\rightarrow {}^4H_\Lambda + \pi^o$$

4. (from Problem 4.32 Griffiths) The Σ^{*0} can decay into $\Sigma^+ + \pi^-$, $\Sigma^0 + \pi^0$, $\Sigma^- + \pi^+$ or $\Lambda + \pi^0$ which is the dominant decay mode. Ignoring the $\Lambda + \pi^0$ mode how many decays to each of the other three modes would you expect if you observed a total of 100 disintegrations with Σs in the final state? Look up the branching ratios in the PDG table. Why can't the $\Lambda + \pi^0$ mode be estimated like the decays to Σs. In order to test your prediction you must compare to a real experimental data and consider statistics. On the basis of statistics how many decays are required to get to summary values in PDG.